



US008429103B1

(12) **United States Patent**
Aradhye et al.

(10) **Patent No.:** **US 8,429,103 B1**
(45) **Date of Patent:** **Apr. 23, 2013**

(54) **NATIVE MACHINE LEARNING SERVICE
FOR USER ADAPTATION ON A MOBILE
PLATFORM**

(75) Inventors: **Hrishikesh Aradhye**, Santa Clara, CA
(US); **Wei Hua**, Palo Alto, CA (US);
Ruei-sung Lin, Redwood City, CA (US)

(73) Assignee: **Google Inc.**, Mountain View, CA (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/565,508**

(22) Filed: **Aug. 2, 2012**

Related U.S. Application Data

(60) Provisional application No. 61/663,381, filed on Jun.
22, 2012.

(51) **Int. Cl.**
G06F 15/18 (2006.01)
G09B 19/00 (2006.01)

(52) **U.S. Cl.**
USPC **706/12**

(58) **Field of Classification Search** 706/11,
706/12, 60
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,974,457	A	10/1999	Waclawsky et al.
6,233,448	B1	5/2001	Alperovich et al.
6,353,814	B1	3/2002	Weng
6,356,885	B2	3/2002	Ross et al.
6,701,144	B2	3/2004	Kirbas et al.
6,813,501	B2	11/2004	Kinnunen et al.
7,076,255	B2	7/2006	Parupudi et al.
7,171,360	B2	1/2007	Huang et al.
7,286,834	B2	10/2007	Walter

7,725,419	B2 *	5/2010	Lee et al.	706/60
7,904,399	B2	3/2011	Subramaniam et al.	
7,991,715	B2	8/2011	Schiff et al.	
8,085,982	B1	12/2011	Kim et al.	
8,095,408	B2	1/2012	Schigel et al.	
8,139,900	B2	3/2012	Gokturk et al.	

(Continued)

FOREIGN PATENT DOCUMENTS

EP	2 048 656	B1	2/2010
WO	2012/006580	A1	1/2012

OTHER PUBLICATIONS

Anonymous, "What is Incremental Learning and Why is it Useful?",
Mar. 12, 2009, Baidu.com.
Amazon Web Services, "Cloud 1305—Machine Learning on
Demand", Jan. 1, 2012, Amazon Web Services LLC.

(Continued)

Primary Examiner — Jeffrey A Gaffin

Assistant Examiner — Ola Olude Afolabi

(74) *Attorney, Agent, or Firm* — McDonnell Boehnen
Hulbert & Berghoff LLP

(57) **ABSTRACT**

Disclosed are apparatus and methods for providing machine-learning services. A machine-learning service executing on a mobile platform can receive data related to a plurality of features. In some cases, the received data can include data related to features received from an application and data related to features received from the mobile platform. The machine-learning service can determine at least one feature based on the received data. The machine-learning service can generate an output by performing a machine-learning operation on the at least one feature. The machine-learning operation can be selected from among an operation of ranking the at least one feature, an operation of classifying the at least one feature, an operation of predicting the at least one feature, and an operation of clustering the at least one feature. The machine-learning service can send the output.

30 Claims, 29 Drawing Sheets

